DEMONSTRATION AND FEASIBILITY OF BOC LoTOx™ SYSTEM FOR NOx CONTROL ON FLUE GAS FROM COAL-FIRED COMBUSTOR

SUMMARY

Oxidation technologies for flue gas NOx control developed in recent years have become commercially successful and economically viable as an alternative to ammonia and urea based technologies using reduction chemistry to remove NOx. Older commercial technologies such as Selective Catalytic Reduction (SCR) and Selective Non-Catalytic Reduction (SNCR), which reduce NOx to nitrogen using ammonia or urea as an active chemical, are limited in their use for high particulate and sulfur containing NOx streams such as from coal-fired combustors, or are unable to achieve sufficient NOx removal to meet new NOx regulation levels. In contrast, oxidation technologies convert lower nitrogen oxides such as nitric oxide (NO) and nitrogen dioxide (NO_2) to higher nitrogen oxides such as nitrogen sesquioxide (N_2O_3) and nitrogen pentoxide (N_2O_5). These higher nitrogen oxides are highly water soluble and are efficiently scrubbed out with water as nitric and nitrous acids or with caustic solution as nitrite or nitrate salts. NOx removal in excess of 90% has been achieved using oxidation technology on NOx sources with high sulfur content, acid gases, high particulates and processes with highly variable load conditions.

The BOC LoTOx™ System is based on the patented Low Temperature Oxidation (LTO) Process for Removal of NOx Emissions, exclusively licensed to BOC Gases by Cannon Technology. This technology has met the stringent cost and performance guidelines established by the South Coast Air Quality Management District in Diamond Bar, CA and has set new lower limits for Best Available Control Technology (BACT) and Lowest Achievable Emissions Reduction (LAER).

The LoTOx™ System for the Control of NOx Emissions uses oxygen to produce ozone as the primary treatment chemical using an ozone generator. The oxidation of NOx using ozone is a naturally occurring process in the atmosphere. The absorption of higher nitrogen oxide by water to form nitric acid is also a naturally occurring process in the atmosphere, resulting in "acid rain". The LoTOx™ System reproduces these naturally occurring processes under controlled conditions within an enclosed system. This treatment method produces the treatment chemical, ozone, on demand from gaseous oxygen in the exact amount required for oxidation of the NOx. Emission of oxygen unused in the treatment process produce no health hazards to plant workers nor to the environment. The ozone is injected into flue gas stream where it reacts with relatively insoluble NO and NO_2 to form N_2O_3 and N_2O_5, which are highly water soluble, and are easily and efficiently removed and neutralized in a wet scrubbing system.

This paper highlights recent progress in the development and commercialization of BOC Gases LoTOx™ technology for NOx removal from coal-fired combustor flue gas. A demonstration of the BOC Gases LoTOx™ System was conducted at Southern Research Institute's (SRI) Combustion Research Facility, Birmingham, AL using a mobile demonstration trailer. The test was the first in a series of tests planned to demonstrate the effectiveness of ozone for oxidation and removal of NOx

emissions from SRI's coal-fired combustor. In the SRI's demonstration tests, two scrubbers were used. The first aqueous limestone spray scrubber removes highly soluble N_2O_5 from the oxidation process along with a high percentage of SOx. The second packed column scrubber with aqueous caustic soda (NaOH) treatment removes most remaining SOx generated from the combustion of sulfur-containing coal. The first scrubber apparatus demonstrates conditions similar to those found on coal-fired combustion systems with existing SOx scrubbers. The LoTOx System demo trailer allows demonstration of the extension of conventional limestone SOx scrubbers for simultaneous NOx and SOx removal. Scrubber effluent can be recovered and tested for materials characterization and wet chemistry analysis. The packed column caustic scrubber allows demonstration of NOx removal where SOx is not present, or on processes where caustic scrubbing or nitric acid recovery would be preferred over limestone scrubbing.

The results from the tests demonstrated that the LoTOx™ System is highly effective for removal of NOx emissions from as high as 350 ppmv NOx to below 50 ppmv NOx levels without significant residual ozone in the exhaust stream. The LoTOx™ System is very selective for NOx removal, oxidizing only the NOx and therefore efficiently using the treatment chemical, ozone, without causing any significant SOx oxidation and without affecting the performance of the downstream SOx scrubber. Furthermore the ozone/NOx ratios required to produce desired NOx oxidation are less than the predicted stoichiometric amounts. Additional tests will be performed using the demonstration unit and the pilot-scale in-duct system at the SRI facility. Various types of coals and fuel types will be used in the combustor. The information gathered will be used for the design of commercial LoTOx™ Systems for effective and efficient NOx removal at utility power plants and other large-scale NOx sources.

BOC Gases
Murray Hill, NJ

Environmental Markets	*Process Plants*	*Gases Technology*
Bob Ferrell	**Bruce Cuddeback**	**Dr. S. C. Hwang**
Mark Anderson		
Dr. Naresh Suchak		
Rob Kelton		

2000 Conference on
Selective Catalytic and Non-Catalytic Reduction
for NOx Control

Radisson Hotel Green Tree
Pittsburgh, PA
May 17-18, 2000